Co composting of pig manure with green wastes to prevent environmental impact of pig production in the Wallis island, French Polynesia.

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Introduction

The archipelago of Wallis is located at 13°15' of southern latitude and 176°10' of western longitude. It covers 159 km² and gathers a principal island and several small islands. Uvea, the principal island, has a surface of 99 km². From its situation, near to the equator and in the middle of the Pacific Ocean, Wallis is characterized by a hot and wet climate. Annual precipitations are strong and generally exceed 3 meters.

The population of approximately 10,000 inhabitants is concentrated on the littoral fringes in the East and the South of the island, in edge of the lagoon. Breeding in Wallis is characterized by the very strong prevalence of the porcine species. But this is a very "strange" breeding which constitutes an essential element of the habit in which it represents the base of the usual exchanges. Pig meat is still little developed in the daily feed ration of the Wallisians, but it is in progression.

According to the 2001 agricultural census (Nuttens, 2003), there would be more than 19,700 pigs distributed in 1,443 breeding. In fact, pigs are present in the majority of the Wallisian households and managed in an extensive way, without real concern as for the impact of the animal manure on the environment. Pig manure is often not recovered and it flows and drains in the closed areas. The strong human and animal densities are a threat for the water resources of the island which come exclusively from a surface sheet of water supplied with the infiltration of the rains. Studies already clearly highlighted the pollution of the water table cloth to the East coast and to the whole of the edges of the lagoon. This alarming situation for the safeguarding of the water resource and human health implied to act on the limitation of the pollution generated by the breedings of pigs. After having taken the first measurements, the local Authorities entrusted to the CIRAD a study on the possibilities of recycling and treatment of pig manure on the island.

Material and Methods

A first mission in 2001 made it possible to characterize the various types of pig breeding and to determine the pig manure composition and flows and consecutively their potential impacts on the environment. First measures primarily aiming to improve the livestock buildings were set up, as also to maximise pig manure recycling practices for dry extensive cultures. Possibilities of financial assistance were created with the profit of the breeders. Moreover, adapted treatment techniques for pig manure surpluses were proposed and, in 2004, the local Authorities decided to study the principle of co-composting pig manure with green wastes. This waste comes primarily from the trees cutting and lawns mowing. They are crushed at their reception on the waste collecting center in Vailepo.

Liquid pig manure composting with solid green waste as a bulking agent makes it possible to optimize the initial composition of the mixture for a better fermentation. Composting itself is preceded by a phase of adsorption of the liquid on the solid. The first step of our work was to determine the adsorption ratio for saturated mixture of pig manure with green wastes. The measure consisted with a complete immersion of green waste in pig manure during 2 hours, then, the mixture is drained until the liquid phase does not run any more. In the second step,

composting performances were tested using pilot-scale windrows monitored for 50 days. One of the windrows was just turned 6 times whereas the second one was also turned but with pig manure addition for the first four turns.

Results

With medium term, for the whole of the island, the potential of production of pig manure would account for 40,150 $m^3.y^{-1}$ containing 30,000 kg of nitrogen and 18,000 kg of phosphates.

For pig manure with a dry matter content (DM) of 15 $g.kg^{-1}$ and crushed green waste with a dry matter content of 557 $g.kg^{-1}$, the adsorption capacity at saturation expressed as liquid vs. solid fraction, is 3.0 $kg.kg^{-1}$ or 5.3 kg.kg DM^{-1}. The results show that suspended matter of the pig manure is retained in free spaces of green waste and the DM retention reaches 0.74 kg.kg DM^{-1}. The water content and wet bulk density of the saturated mixture are respectively 76% (w/w) and 829 $kg.m^{-3}$.

During the active phase of composting, the change of the temperature inside the 2 windrows is influenced by turn operations. The maximum temperature is higher (63°C) in the windrow without pig manure addition than in the other one (57°C). But finally in the 2 cases, the temperature falls near the ambient temperature after 47 days.

After a maturation during 60 days additional, the weight of dry compost accounts for 65% of the initial dry weight, 56% in the case of liquid manure addition along composting.

Discussion

Knowing the total cultivated area of 720 ha in Wallis, it would be initially easy to bring back the quantity of pig manure produced to this surface, to affirm that one is very far of a nitrogen or phosphorus surplus. In fact, all cultivated surfaces are not accessible for spreading, far is necessary…since this area is divided into step less than 1,667 farms with a total of 5,002 fields! So it is certain that spreading on fields will not make it possible to eliminate all the produced pig manure. A treatment of the surpluses is thus quite necessary on the island.

As a result of the adsorption ratio measurement, the calculated free air space in the mixture is 25% (v/v), which is a low value for oxygen renewal during composting (Eftoda & McCartney, 2004). It has been decided to use 60% of this adsorption capacity for the windrow recipe.

Composting of pig manure and green wastes mixtures within turned windrows is easy and the active fermentation duration is near 50 days, after what, maturation is necessary during 60 other days. The final compost seems to be a good organic amendment to be completed with fertilizers. Only the chromium and nickel contents seem a little high.

Conclusion

On the Wallis island, the prevention of pollution due to the pig manure would pass by its maximum valorization by spreading in the accessible cultivated zones and by a composting treatment for the surpluses. Green waste constitutes the only bulking material available on the island. Their capacity of adsorption of the pig manure is high but it would be advisable to check their potential flow rate along the year.

References

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